

## **Paper 5: Exploring the Personal/External Domains: Investigating Changes in Epistemic Orientations During Sustained Collaborative Professional Learning**

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### *Abstract*

Current reform efforts in science education focus on creating environments where students grapple with and negotiate their own understandings and mechanistic explanations of scientific phenomena by using their knowledge of disciplinary content and science practices. In order to support this reformed vision, effective professional development (PD) for science teachers is critical. If PD is to shape teachers' practice, teachers must experience a change in attitudes and beliefs. The research presented here explores the epistemic orientation of three secondary science teacher cohorts who were supported in different iterations in a larger professional development study. The epistemic orientation toward teaching science survey was administered at three time points for each cohort and paired sample t-tests were performed to analyze composite and dimensional scores. Our analysis revealed that change in epistemic orientation occurred for teachers who engaged in two years of supportive PD, but that one year of support was not sufficient to engender change in epistemic orientations. These findings further support the need for continuous, high-quality, longitudinal PD when the goal is a shift in science teachers' epistemological beliefs and teaching practices.

### **Research Question**

Having previously addressed other domains of the IMTPG, this study focuses on the external domain and PD influence on teacher belief. With student-centered instruction as a primary focus of reform efforts, PD programs that generate shifts in teachers' attitudes, beliefs, and practices are critical (Desimone, 2011; Hand et al., 2018; Suh, 2016). **The research question that propels this study is: What impact does sustained PD have on science teachers' epistemic orientation?**

### **Design/Procedure**

This quantitative study employed paired-sample t-tests to examine survey data collected over multiple time points from teachers in longitudinal PD.

**Instrument:** The Epistemic Orientation toward Teaching Science (EOTS) Survey (Park, et al., 2018) was used, consisting (of 44 five-point Likert scale items across four dimensions (epistemic nature of knowledge, epistemic alignment, classroom authority and student ability. This survey was selected as it provided insight into teacher belief through their orientation to teaching science. .

**Participants:** We look across the three iterations of the PD:

- The longitudinal cohort (Co1)-who engaged in the PD for 3 years
- The abbreviated cohort (Co2)--who engaged in the PD for one partial year (the in-school cycles shortened due to Covid)
- Field study cohort (Co3) -who engaged in one of two versions of the PD (LCD or LTP) for a full year and was made up of two sub-groups (LCD, and LTP).

**Data Collection:** The EOTS was administered to all cohorts prior to the summer PD institute that they attended and after the first year of in-school cycles. For Co1 the survey was also administered after the second year of project support (Post-Y2). For Co2 and Co3 the EOTS was also administered after summer PD.

### Findings and Analysis

Mean composite scores were calculated and for all participants (n=22) scores began relatively high before the summer PD and continued to approach the maximum score of 15.36. [The closer an EOTS score is to the maximum, the more desirable a teacher's epistemic orientation for implementing science practices in their classroom (Park et al., 2018).]

Paired sample t-tests were performed across the three-time points for each of the cohorts. For Co2 and Co3 no significant differences were found between mean composite scores or between mean dimensional scores. For Co1, there was a significant difference in mean composite scores seen between Pre-Y1 and Post-Y2,  $t(3) = -3.30$ ,  $p < 0.05$  (Table 3). There were no significant differences between mean scores for the four dimensions of the EOTS from Pre-Y1 to Post-Y1; however, for the Epistemic Alignment dimension, a significant difference between mean dimensional scores from Pre-Y1 to Post-Y2 was found,  $t(3) = -6.57$ ,  $p < 0.05$  (Table 4). A significant difference for the Student Ability dimension from Pre-Y1 to Post-Y2 also occurred,  $t(3) = -3.22$ ,  $p < 0.05$  (Table 5). As well, the Student Ability dimension showed a significant difference between mean dimensional scores from Post-Y1 to Post-Y2 surveys,  $t(3) = -3.43$ ,  $p < 0.05$  (Table 5). All significant changes in scores are in the positive direction.

Table 3. Co1 Paired T-Test EOTS Composite Scores

	<i>Pre PD</i>	<i>Post Y2</i>
Mean	11.61	12.44
Variance	1.042	0.461
Observations	4	4
t Stat	-3.304	
P(T<=t) two-tail	0.051	

Table 4. Co1 Paired T-Test EOTS Epistemic Alignment Dimension

	<i>Pre PD</i>	<i>Post Y2</i>
Mean	3.91	4.16
Variance	0.12	0.09
Observations	4	4
t Stat	-6.571	
P(T<=t) two-tail	0.014	

Table 5. Co1 Paired T-Tests EOTS Student Ability Dimension

	<i>Post Y1</i>	<i>Post Y2</i>
Mean	3.56	4.38
Variance	0.22	0.35
Observations	4	4
t Stat	-3.43	
P(T<=t) two-tail	0.04	

  

	<i>Pre PD</i>	<i>Post Y2</i>
Mean	3.69	4.38
Variance	0.89	0.35
Observations	4	4
t Stat	-3.22	
P(T<=t) two-tail	0.056	

These findings support that the change in epistemic orientations occurred for teachers after two years of PD consisting of 36 hours of summer PD and two years of intensive in-school follow-up, however as seen in Cohorts 2 and 3, one year of PD including 36 hours of summer PD and in-school follow-up was not sufficient to engender such changes. The sustained focus of the PD on learning how to foster productive science talk over time, when occurring over two years, supported teachers to shift their epistemic orientations in ways that align with desirable instruction of science content and practices (NGSS Lead States, 2013).

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